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Studying Levels of Presence in a Virtual Environment Simulating Drug Use in Schools: Effect on Different Character Perspectives

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Abstract

This paper studies the aspect of presence in a Virtual Reality (VR) environment that can be used for training purposes in the education sector and more specifically for teacher training and professional development. During the VR experience trainees had the chance to view the world from different perspectives through the eyes of different characters appearing in the scene. The experimental evaluation conducted aims to examine the effect of viewing the experience from different perspectives and viewpoints in relation to the overall user experience and the level of presence achieved. To accomplish these objectives an experiment was performed investigating presence and the correlation between presence and different viewpoints/perspectives. To measure presence a combination of methods were used including two different questionnaires, the use of an eeg device, EMOTIV EPOC+ and the analysis of heart rates. The results indicate that high levels of presence were recorded and that increased levels of presence are associated with viewing the VE from a student rather than a teacher perspective.

CCS Concepts
• ***Computing methodologies*** → ***Virtual reality;*** • ***Software and its engineering*** → *Virtual worlds training simulations;*

1. Introduction

This paper aims to investigate how the levels of presence in a VR environment, are affected by different perspectives. More specifically the investigation refers to a virtual world developed for training purposes guided by the needs in the education sector, and more specifically addressing the needs for the professional development of teachers. The need to use Virtual Reality (VR) as part of teacher training derives from the lack of comprehensive practical training in teacher preparation. Thus, teachers are in the need of a safe environment to train, representing real-life conditions that will allow them to use trial and error techniques but without risking harming in any way real students. Moreover, it is of paramount importance for teachers to be able to understand student's disorders including problems such as drug use disorders. The use of VR can provide a target group, like teachers, a safe environment with real-life based scenarios for training and at the same time it can allow teachers to understand in depth student's disorders by seeing events from different perspectives that includes perspectives of students participating in a VR classroom. Such a training taking advantage of VR technology and by offering the possibility to experience situations from another person's perspective will maximize teacher's professional development and cultivations of skills such as empathy [Bat09].

Thus, we propose a novel Virtual Reality (VR) application that could be used to support systematic teacher education in an effort to cultivate empathy skills regarding substance use in schools. Literature regarding the use of VR in teacher education is extremely limited, while to the best of our knowledge, substance use related training scenarios have not been used so far as part of teacher training. Using VR based methodology will allow teachers to put themselves in the position of a student that faces substance use problems in the school environment, in order to understand in depth, the problem and raise awareness. Another significant point is that the proposed VR based methodology is addressing a real problem of inadequate practical training in teacher education, while the scenario is based on real-life incidents and real teacher's needs. In the long-term we aim to develop a VR tool that could be implemented as part of teacher education within the universities or other organizations.

Although the cultivation of empathy was a key part of the experiment, this paper is focused on the outcomes regarding participant's levels of presence. Presence is a major component part of a VR system, yet the actual factors causing it have not completely being identified. Among factors that may influence presence in VE's, interaction with the virtual environment seems to be the strongest factor [SVdM99]. As teachers are a very specific target group and

not necessarily familiar with VR technology, it is essential to investigate whether the experience of teacher trainees in a virtual school world can provoke presence or their feeling that they are part of the computer generated environment during their experience. Presence can cause participant's the feeling of transportation to the virtual environment and thus participant's perception of being part of the virtual world can affect their stimuli and make them react within the virtual world as if they were in the real one [LD97, Rog17]. As the purpose of using VR in teacher training is the ability to train teachers in a real-life based situation, their reactions need to be as if they were in the real world, hence enhanced level of presence is of primary importance for this research.

At the beginning of the paper, a conceptual explanation of the term presence is presented indicating its significance for participant's experience in a VR system and thus for this particular research. Then, the experimental setup is being presented along with the methodology used and the results. At the end of the paper, conclusions regarding the knowledge gained from the experiment and future research directions are outlined.

2. Literature review

2.1. Presence

A great amount of research on VR is focused on the concept of presence, from its definition and theories, to its measures and causes. Presence can be defined as "being there" [Väs03]. The definition used in this paper will be the one by Slater and Sanchez-Vives [SSV16] - "the illusion of "being there" in the environment depicted by the VR displays". The feeling of presence "gives users the subjective impression that the virtual environment in which they are immersed really exists" [Bou10]. Because of presence, although users know that they are not in the real-life situation within the VR environment and that their experience is mediated by technology, they tend to behave as if they were in the real world [SVDSKVDM01]. For this reason, the concept of "presence" is categorized as transportation, because people usually report that they sense of being in the virtual world.

The importance of researching presence in immersive VR is high, because a VR world can evoke the same emotions and reactions in people as a real one [HKM*94, RSF98]. Thus, examining the sense of presence in a VR system is essential for the design of such a system as the level of presence has an impact to the usefulness an efficiency of the system. Moreover, according to Lombard and Ditton (1997) [LD97], understanding how sense of presence works in a VR system will also help understanding how the physiological processes of the users are generated while using the system.

The factors contributing to presence have also interest researchers through the years and are important for the effective design of virtual environments. Slater and Usoh (1993) [SU93] identified five factors; (i) high quality and resolution information. (ii) consistency across all the displays. (iii) interactivity (iv) the user must have a virtual body in the VE (v) effect of action should be anticipated. In an effort to achieve maximum levels of presence for the participants all five factors identified them were adopted.

When it comes to measuring presence, the measures can be divided into subjective measures like questionnaires [WS98, UCAS00] and objective measures that be grouped into behavioral [She96] and physiological measures [MIWB00]. According to Schuemie et al. (2001) [SVDSKVDM01], presence is measured mainly by questionnaires, which according to the authors is beneficial to the development of the theories on presence, as the results offer significant insights. However, the authors also state that many of questionnaire used to measure presence have been proven to be unreliable and thus, the results obtained by empirical research have to be validated with precaution. For this reason in the current research several approaches have been used including the use of questionnaires to measure presence along with electrophysiological monitoring method to record electrical activity of the brain.

Sense of presence plays a key role in a VR system; however, it has been neglected as a subject for research, therefore, further research is required in order to investigate the factors that affect the users' sense of presence. Additionally, the levels of presence can affect positively skill training. This is a significant advantage of VR systems and for this reason VR is used for training purposes in fields such as military, surgery and pilot training, as they VR can be more beneficial than low presence media such as textbooks. Thus, as the proposed VR system aims to train teachers to maximize their professional development, the investigation of the levels of presence is an important part of the current research.

3. Experimental design

In this section we describe the experimental set up used as the basis of our investigation that aims to assess the suitability of VR for training teachers regarding drug related problems in schools.

3.1. Scenario

The scenario was based on a real incident that took place in 2017 in a school that involves an attempt to give substances to a 12-year-old student by his classmates, in the form of pills and after threats [Kou17]. The scenario takes place in the school outdoors space during break time. A student (named Anna) is watching her classmate (Nikos), who is sitting on a bench, having done substance use and is having delusions and hallucinations as a result of it. Anna is trying to find out by asking another classmate (Kostas) what has happened to Nikos and after revealing the drug use, Kostas is trying to pressure Anna to smoke a cannabis cigarette.

3.2. The substance and its effects

The substance that is portrayed in the scenario is cannabis (also mentioned as marijuana in the scenario, which is a name for the cannabis plant and more specifically a drug preparation from it). Participants in Group 1 "took the place" of the drugged student so they had to virtually "experience" the effects of this drug. For this purpose, motion blur was added to the camera and the colors were brighter (marijuana may cause head rush or dizziness and heightened sensory perception) [TKR14, oDA18]. Additionally, the eyes of the avatar of the drugged student were colored red (which is one of the most noticeable effects after smoking marijuana) [HC16]. Lastly, the audio files of the dialogues were modified (by lowering the pitch and adding echo effects) and the font of the speech

bubbles' text that was appearing next to the person that was talking was changed so that the words were not easily readable. A between-group design experiment was conducted. The 25 participants were divided into two groups according to the two perspectives they witnessed in the virtual world. They were three perspectives in total:
Perspective I: Teacher perspective (TP) (Figure 1, top)
Perspective II: Student-drug user perspective (SDUP) (Figure 1, middle)
Perspective III: Healthy student perspective (HSP) (Figure 1, bottom)

Figure 1: *The virtual environment as seen from the teacher's (top), student drug-user's (middle) and healthy student's (bottom) character perspective.*

The two groups were:
Group 1: The participants viewed TP + SDUP
Group 2: The participants viewed TP + HSP
Both groups viewed the teacher perspective of the drug incident in the school environment. In each perspective, the participants were observing the scenario through the eyes of their avatar (first-person perspective - 1PP). Their body and head movements were mapped in real time to the virtual body (they were tracked by specialized equipment), seen both by looking directly down at their real body and in the virtual mirror which was located in front of them at the beginning of each perspective (Figure 2). This setup is called embodiment [SSV16].

Figure 2: *A virtual mirror in which the participants could see their virtual self (in this case the teacher).*

3.3. Virtual world development

The VR system that was used for the experiment included the Head Mounted Display (HMD) Oculus Rift CV which was coupled with a positional tracker. The physical movements of the participants were tracked using the motion sensing device Kinect for Windows v2 and mirrored to the avatar they were controlling in the virtual world. The desktop computer used was equipped with an NVidia GeForce GTX 1070 graphics card and 16GB RAM. In order to proceed through the dialogues in the virtual world the participants used the Oculus Remote. The VR application was developed with the Unity game engine. The 3D avatars (teachers and students) were created using the online software Autodesk Character Generator, in which a skeleton was also added to the models as well as facial blend shapes, so that their mouths could move according to the dialogues recorded. The voice lines of the dialogues of the scenario of the application were recorder using a Philips digital recorder and edited in the software Adobe Audition CS6. Additionally, the fitness wristband fitbit charge 2 was used for the measurement of the participants' heart rate and the 14-channel wireless EEG EMOTIV EPOC+ for the recording of the brain signals.

4. Methodology

4.1. The research question

The aim of the current research was to investigate the levels of presence in a VR training system for teachers. Moreover, another goal was to identify whether the different perspectives that the participants experienced within the virtual world affected the levels of presence. This article addresses two research questions that are the following:

1. Did the participants during their experience in the virtual school world felt a sense of being in the virtual environment or did they perceive the virtual world as a set of images?
2. Was the level of presence of the participants affected by the perspective that the VE was observed?

4.2. The sample

A total number of 25 participants (n=25) took part in the experiment, 72% (n=18) female and 28% (n=7) male. 88% of the participants (n=22) were from Cyprus, one participant from Greece, one from Serbia and one from Ukraine. Regarding the perspectives

that the participants experienced, 52% experienced the perspective of the teacher and the students drug user and 48% experienced the perspectives teachers and student Anna. Most of the respondents aged from 18 to 39 years old (84%), 8% aged from 40 to 49 and 8% aged from 50-59 years old. According to the results, the majority of the participants (64%) were active teachers, serving in secondary (36%), higher (24%) and primary education (4%), while 36% of the participants were not currently employed as teachers. Data on participants' demographics and specialty selected revealed a variety of fields including computer science (20%), multimedia and graphic arts (16%), mathematics (12%), literature (12%), foreign languages (8%), primary education, physical education (sports), sociology, speech pathology and web design. Furthermore, data on participants' experience in using VR environments, indicated participant's unfamiliarity with VR, as 36% claimed to have never use VR in the past, 32% claimed to have 'a little' experience, 12% claimed to have 'moderate' experience, 12 claimed 'much' VR experience and only 8% claimed to be 'very much' familiar with the use of VR.

4.3. Data collection

A combination of methods was used to acquire the data necessary to answer the research question. Quantitative data were collected using two questionnaires completed before and after the experiment, while heart rate and brain signals were also recorded during the VR experiment. The pre-questionnaire contained three parts, one for collecting demographic information, a second part for evaluating teachers' empathy, and a third part aiming to record participants mood states before the experiment using a scale based on the Positive and Negative Affect Schedule (PANAS) [WCT88]. The post-questionnaire contained three parts, the first part aimed to evaluate participant'âĂŹs sense of presence in the virtual world using Slater-Usoh-Steed Questionnaire (SUS) [UCAS00] and six additional questions to measure the level of embodiment they felt inside their virtual body. The second and third part was identical to the pre-questionnaire in order to identify how participant's experience in the virtual world affected their empathy and mood states. However, at the current paper the results of embodiment, empathy and participants' mood states will not be presented as the analysis has not yet completed [SBC*18]. Furthermore, user statistics, recorded from users' head movement through Oculus, was recorder in real time through the VR application and was used to track where the user was looking throughout the procedure.

4.4. The procedure

The participants took part in the experiment one at a time. At first, they had to read the consent form of the study very carefully before participating in the research study. Afterwards, they had to fill the pre-questionnaire online. After the completion of the pre-questionnaire the eeg device used, EMOTIV EPOC+, was placed on the participants along with the Oculus Rift CV (see Figure 3). Moreover, the participants had to wear the wristband to their left hand and placed in front of the Kinect. During this process, the participants were also informed about the scenario and the two perspectives that they would experience, while information were also provided regarding the way to interact within the virtual world. At the beginning of each scene, a mirror was in front of the position of the avatar, so as for the participants to perceive and become familiar with their virtual body and environment. The exposure of the participants in the virtual environment lasted approximately 5 minutes, depending on the pace with which they were advancing the dialogues of the two scenes. After they were finished, the HMD, the EMOTIV EPOC+ and the wristband were taken out and the participants was asked to complete the post-questionnaire online.

Figure 3: *One of the participants wearing EMOTIV EPOC+ and Oculus Rift*

5. Results

After the data has been collected, the results of the presence questionnaire were analyzed with the use of SPSS software (Statistical Package for Social Sciences), while the eeg data were analyzed using MATLAB software and specifically using EEGLAB toolbox.

5.1. Presence questionnaire results

Cronbach's Alpha coefficient of internal consistency shows that the instrument has good enough reliability in our sample (Alpha=0.863). The six items related to sense of presence had a 7-scale score range from -3(not at all) to 3(very much). The average score for the sense of "being there" in the school space was 4.88 (SD=1.69), indicating participants' tendency to slightly feel of being there in the school virtual space. The results indicated that participants tended to somewhat agree that there were times during the experience when the school space was the reality for them (M=4.68, SD=1.60). According to the results, the virtual school space was not experienced by the participants as just perceiving pictures, yet they did not feel it as a place they visited as they tended to score from neutral to slightly agree (M=4.28, SD=1.46). Moreover, the results suggest that during their experience in the virtual world the participants did not feel like being elsewhere, yet they also did not feel as being in the school space as they tended to score from neutral to slightly agree (M=4.28, SD=1.51). Moreover, participants did not find the virtual school space as a place in a way similar to other places that they have visited the day of the experiment, yet they did not completely disagree as they tended to be neutral (M=3.7, SD=1.84). The outputs also state that the participants during their experience in the virtual world slightly thought that

they were really standing in the school space (M=4.8, SD=1.56). The results from the tests of normality (namely the Kolmogorov-Smirnov Test and the Shapiro-Wilk Test), revealed that most of the items are below 0.05, therefore, the data significantly deviate from a normal distribution and non-parametric tests were used for the analysis.

A Mann-Whitney U test was used to investigate possible differences between the two different perspectives (teacher-student drug user and teacher-healthy student) experienced by the two groups of participants regarding the sense of presence. The hypothesis used are:

The null hypothesis H_{null}: The two groups that experienced the two different perspectives have the same distribution of scores.

The alternative hypothesis H_{alt}: The two groups that experienced the two different perspectives do not have the same distribution of scores.

A Mann-Whitney U test showed that are is no significant difference regarding the sense of presence between the two groups of participants that experienced the different perspectives as the p-value is for all the items is >0.05. From the data, it can be concluded that regarding the sense of presence in the school environment there was no statistically significantly difference between the two groups (U=48, p=.095). Moreover, no statistically significantly difference was found regarding the extent at which the experience within the virtual school space was the reality for the participants (U=65, p=.48) or regarding participants' perception of the virtual space as images that they saw, or more as somewhere that they visited (U=49, p=.10). The different perspectives did not affect participants' scores regarding the sense of being in the virtual school space, or of being elsewhere (U=63, p=.40) or participant's opinion regarding the similarity of the virtual world to other places they had visited that day (U=64, p=.44). Finally, according to the results the different perspectives did not affect participant's opinion regarding their thought of actually being in the virtual school space (U=57, p=.24).

A Spearman's rank-order correlation was run to determine the relationship between the items of presence questionnaire for the two groups that used the different perspectives in the virtual school environment. The results indicate that there is no correlation between the different perspective and the variables of presence as p=< .05 for all of the items. However, some strong positive correlations were found among the variables of presence. Participants' sense of "being there" in the school space was very strong and positively correlated to the extent at which their experience within the virtual school space was the reality for them (rs= .83, n = 25, p < .001) (see Figure 4). Thus, large values of sense of presence are associated to large values regarding participant's feeling the virtual school space as a reality for them.

Additionally, the test of correlation also reported a strong positive correlation between participants' sense of "being there" and the perception that the virtual world not just as images but a place that they visited (rs= .75, n = 25, p < .001). There was a strong positive correlation between participants' sense of presence and their perception of being in the virtual school space or elsewhere (rs= .65, n = 25, p < .001). Moreover, there was a strong positive correlation between participant's sense of presence and their perception of actually be in the virtual school space (rs= .74, n = 25, p < .001). A Spearman's rank-order correlation also revealed a strong positive correlation between participants' experience in the virtual environment as a reality and the perception of the virtual world as images or as a place that they visited (rs= .72, n = 25, p < .001). Thus, the more participants felt the virtual environment a reality for them, the more they felt that they visited the virtual school. Moreover, according to the results, the more participants felt the virtual environment a reality for them, the more they felt being in the environment (rs= .71, n = 25, p < .001) and the more they felt that they were standing in the virtual school space (rs= .78, n = 25, p < .001). The results revealed another strong positive correlation between participant's perception of the virtual school as images or as a place they visited and sense of presence (rs= .81, n = 25, p < .001) (see Figure 5). Thus, the more participants felt the virtual school as a place they visited, the stronger the sense of presence was. Additionally, the more participants felt the virtual school as a place they visited, they more they thought that they were standing in the virtual school space (rs= .81, n = 25, p < .001) (see Figure 6). Finally, according to a Spearman's rank-order correlation the more participants felt that they were standing in the virtual school space, the more present they felt (rs= .81, n = 25, p < .001) (see Figure 7).

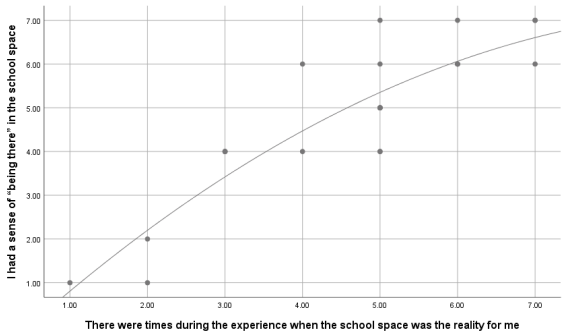

Figure 4: *The strong positive correlation between the sense of presence and participant's perception of the virtual school as a reality*

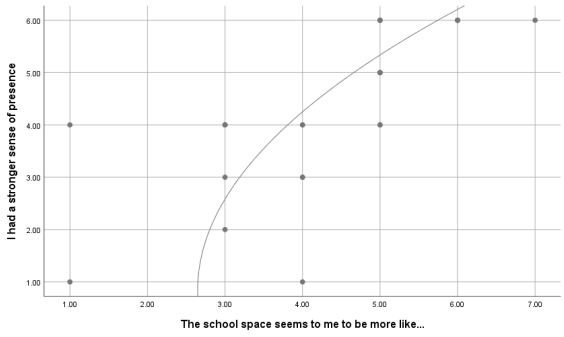

Figure 5: *Correlation between participant's perception of the virtual school as images or as a place they visited and sense of presence*

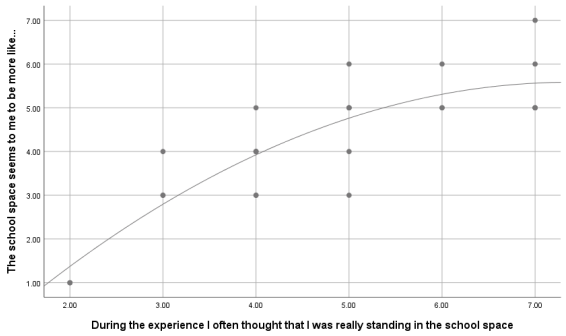

Figure 6: *Participants' perception of the virtual school as a place they visited strongly correlated to their belief that they were standing in the virtual school space*

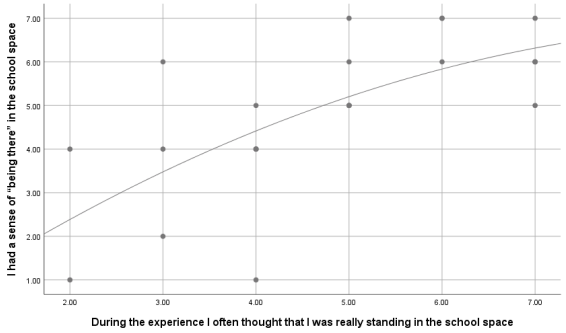

Figure 7: *A strong positive correlation indicating that participants' belief of being actually in the school space raised the levels of presence*

5.2. Eeg results

For further validation of our results, we recorded brain signals from several brain areas using a wireless EMOTIV EEG device. We recorded separately the three aforementioned perspectives (teacher, user and healthy) and we were focused mainly on the frontal and parietal areas of the brain. It has been proved that parietal area plays an important role in the experience of presence [KKN12, BSMTL18] and can be used as a measure for the validation of its existence. Frontal lobe is associated with cognitive tasks, decision making and attention [SK08]. Moreover, we calculated the general dominant frequency of the brain for the three perspectives. For the analysis of the data, EEGlab was used, a MATLAB toolbox.

Table 1 presents the results for each brain area based on each perspective. We can clearly see that when the participant had the experience of a student (user or healthy), there is a difference mainly for the parietal area and the general frequency. This difference concerns different brain states, such as beta state, which ranges from 12.5 to 35 Hz and alpha state from 8 to Hz. In order to validate the sense of presence we need the existence of alpha state in the parietal area, which is apparent only in the student perspective. Based on a Mann-Whitney U test we found that there is a significant difference between these perspectives for the parietal area (p=0.013 <0.05) and for the dominant frequency (p=0.012<0.05) (see Figure 8 and Figure 9).

	Frontal (Hz)		Parietal (Hz)		Dominant Frequency (Hz)	
	Mean Value	Std. Deviation	Mean Value	Std. Deviation	Mean Value	Std. Deviation
Teacher	12.8	3.8	14.1	4.6	15.4	5.4
Student Drug-User	12	4.4	11.7	3.5	12.6	3.1
Student Healthy	13.5	3.8	12.2	3.7	12.7	3.3

Table 1: *Results for each brain area based on the perspective*

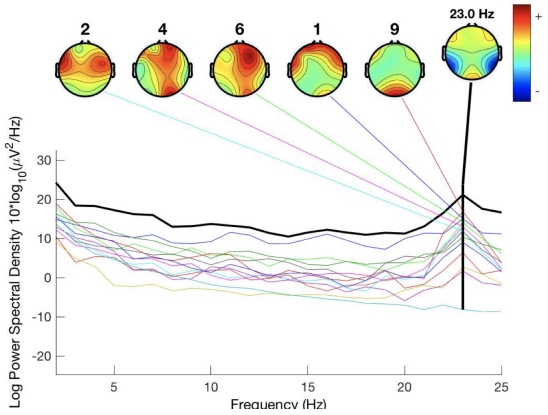

Figure 8: *Dominant Frequency for Teacher Perspective. The diagram was constructed after Independent Component Analysis (ICA).*

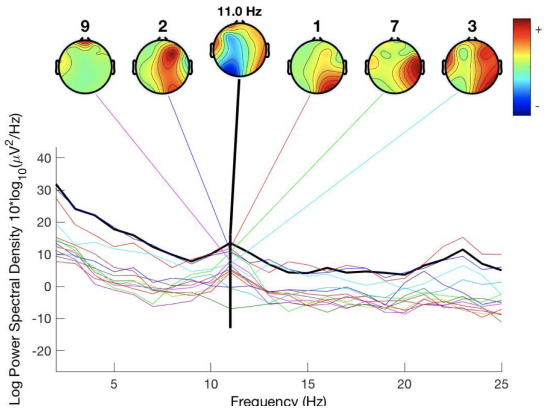

Figure 9: *Dominant Frequency for the healthy student perspective. The diagram was constructed after Independent Component Analysis (ICA).*

We run a Kruskal-Wallis test to compare all the three perspectives. Given that we found a statistical significant difference for the parietal (p=0.042) and for the dominant frequency (p=0.039), we used a Mann-Whitney test to compare them in two groups. So, we noticed that there is a significant difference for the teacher-user group with p =0.043 for the parietal area and p=0.047 for the

dominant frequency as well as for the teacher - healthy group with p=0.049 for the parietal area and p=0.040 for the general frequency. Frontal area never presented a significant difference between any group or perspective. As we can see in the table, we found alpha or low beta for all the perspectives which means that in all cases participants faced a cognitive task in which they were concentrated. On the other hand, the sense of presence was noticed only in the student (healthy and user) perspective, which means that during the teacher one, participants maybe didn't find so much interest or they didn't feel they actually were in the position of the teacher. On the contrary, during the student perspective, participants felt more involved in the process and this is also presented in the dominant frequency, which represents the alpha state. In Figure 10 we can see an example of a channel in the parietal area, indicating this alpha state.

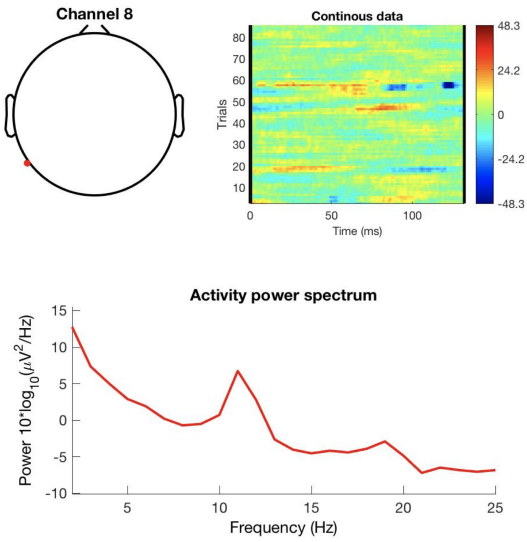

Figure 10: *Example of a channel in the parietal area for the student user perspective. We can notice the peak of the frequency at around 11 Hz, which is a clear alpha state.*

5.3. Heart rate

During the experiment participant's heart rate was measured to identify possible changes in their heart rate during the VR experience. The results revealed a significant difference between the beginning and the end of the experiment. HB1 represents the heart rate at the beginning of the experiment, with a mean of 80.92 bpm and a standard deviation at 10.59 bpm, while HB2 shows the heart rate at the end of the second perspective and of the experiment, with the mean value at 87.21 bpm and standard deviation at 10.97 bpm (see Figure 11 below).

6. Conclusion and future thoughts

The current research aimed to investigate the levels of presence in a VR system designed for training purposes in an effort to maximize the professional development of teachers and the cultivations

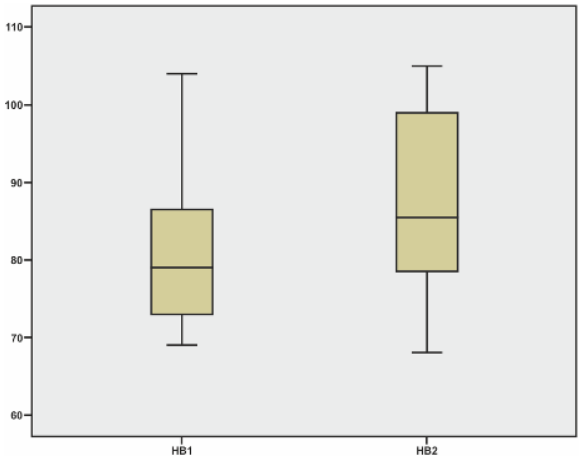

Figure 11: *Participant's heart rate before and after the use of VR*

of their skills and competencies such as empathy. The main objective of the experiment was to investigate the levels of presence elicited by the virtual world. Moreover, another key objective was to investigate whether the experience of two different perspectives (teacher/student drug user and teacher/ healthy female student perspective) by the participants had an impact to the level of presence.

From the data it can be concluded that presence was achieved as the participants reported that they felt as being part of the virtual school space. Although the reported levels of presence did not reach the maximum score of the likert scale, it is significant that none of the participants reported the virtual world as images but as a place they they visited. One possible factor for the medium levels of presence could be participants' inexperience with the use of VR. Heeter (1992) [Hee92] argues that users' prior experience with the virtual worlds might play a role in presence and suggests that the more familiar the users are with virtual worlds the more likely it is that the sense of presence is increased. Therefore, the unfamiliarity of the sample with virtual worlds could have lead to the lower levels of presence. Nevertheless, the VR system provoked participant's sense of presence as the users felt inside the virtual school environment. Moreover, the results indicates several strong and positive correlations among the difference items of presence indicating that the virtual school world provoked presence in the sense of being there visiting in the virtual school.

Regarding the impact of the different perspectives that the participants experienced to the levels of presence, the results of the questionnaire did not confirm a statistically significant difference. Thus, changing a perspective towards the substance use event during the scenario did not affect participant's levels of presence. However, it should be noted that the post-questionnaire was given after the completion of the experiment and the experience of both perspectives. As a result, the possible change between the perspectives would be difficult to be recorded within the questionnaire.For that reason, we used the EEG recording to be able to have a further result and validate the ones retrieved from the questionnaire. Our data confirmed the sense of presence but only for the perspective of the student. This fact put as in a position to believe that participants

who had the experience of a teacher didn't find the proper interest in order to be embedded, maybe because it is a position they face everyday.

Moreover, as the sample was small further research is required in order to determine the relationship between presence and the experience of different perspective. As educators are a sample very unfamiliar with the use of virtual reality and for many of the participants this was the first contact with a VR system, it is possible that the change of perspectives did not affected the way they experienced the virtual world.

It should also be noted that some results are still under analysis that will also determine further research in the field. A second questionnaire was also used to measure presence and there are indications that the results will confirm the results of SUS questionnaire regarding presence. Empathy results are also under analysis and the results will determine whether participant's empathy skills showed any difference after the VR experience and whether there is a correlation with presence or participant's mood states.

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